Application of ECRH/ECCD on FTU: an overview of recent results

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The ECRH system (1.6 MW, 0.5s, 140 GHz) has been widely exploited on FTU tokamak (4-8 T; 0.3–1.6 MA; 0.3– 4x10 ^{20} m^{-3}) with several aims in the last 10 years. In this talk we report the main recent results applying EC waves for: suprathermal current drive, MHD activity control and disruption mitigation. The simultaneous presence of a LH (8 GHz, 1.5 MW in the reported experiments) and an EC systems gives the possibility to investigate the interaction between the EC waves and the fast electron generated and sustained by LHCD. The mostly used suprathermal EC absorption scheme in FTU is at down-shifted frequencies, with central B_{To} (7 T) greater than the resonant one (5T). Experiments carried out with I_p=500kA, n_e=6-8 $10^{19}m^{-3}$ and $N_{//}^{EC}$ ranging from 0 to ±0.5 have shown a measured overall current drive (CD) efficiency well above that due to the sum of those expected for the two waves. This fact is ascribed to the clear existence of a synergy that apparently increase EC efficiency close to 0.1 $10^{20}AW^{-1}m^{-3}$. The consequent modification of current profile is well supported by FEB data.

EC waves are the most promising candidate for NTM stabilization/control on ITER. In this frame several studies has been carried out on FTU regarding MHD control by ECRH/ECCD. By means of the high power density of the launched EC beam a reproducible control of both saw-teeth activity and Tearing Modes has been obtained, confirming the capability of ECH/ECCD term to locally modify the current density profile. Experiments on real time m=2, n=1 mode stabilization [1] with EC waves are reported, and a description of the control algorithm, based on ECE signals for the detection of the island position and the EC deposition radius, is given.

Experimental observations on FTU have demonstrated the role of ECRH in suppressing (or reducing) an existing runaways population in the plasma [2]. This can be of great interest to prevent damage caused by runaway electrons generated during the current quench. For this purpose a series of experiment to study the direct influence of ECRH power on the disruption evolution has been carried out in FTU. Controlled disruptions have been made by injection of impurities (typically Mo) through laser blow-off or by increasing the electron density above the Greenwald limit using gas puffing. The ECRH power (up to 1.1 MW) has been triggered by the loop voltage signal used as a disruption precursor. Magnetic coil measurements and soft-x ray tomography reconstruction results indicate that ECRH, in addition to having some effects on the runaway population [3], is acting on the magnetic island evolution, therefore leading, depending on the deposition position, to disruption avoidance and/or to current decay softening. ECRH is found to be effective in disruption avoidance when the deposition location is r/a=0.6 in Mo injection cases and r/a=0 in density limits cases.

References

[1] see Cirant et al., this Conference
[2] J.R. Martin-Solis et al., N.F. **44,** (2004) 974
[3] B.Esposito et al., 32nd EPS- ECA Vol.29C, P-5.072 (2005)